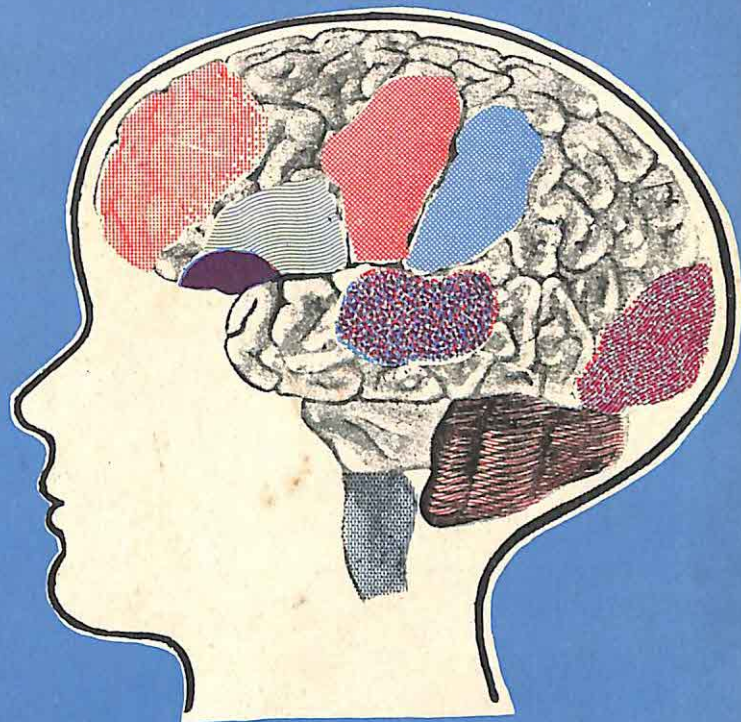
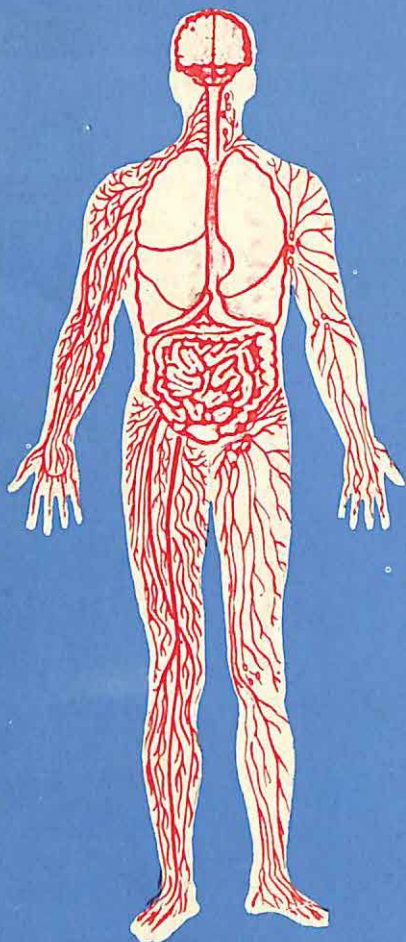


THE HUMAN BODY



By Cyril Bibby and Ian T. Morison



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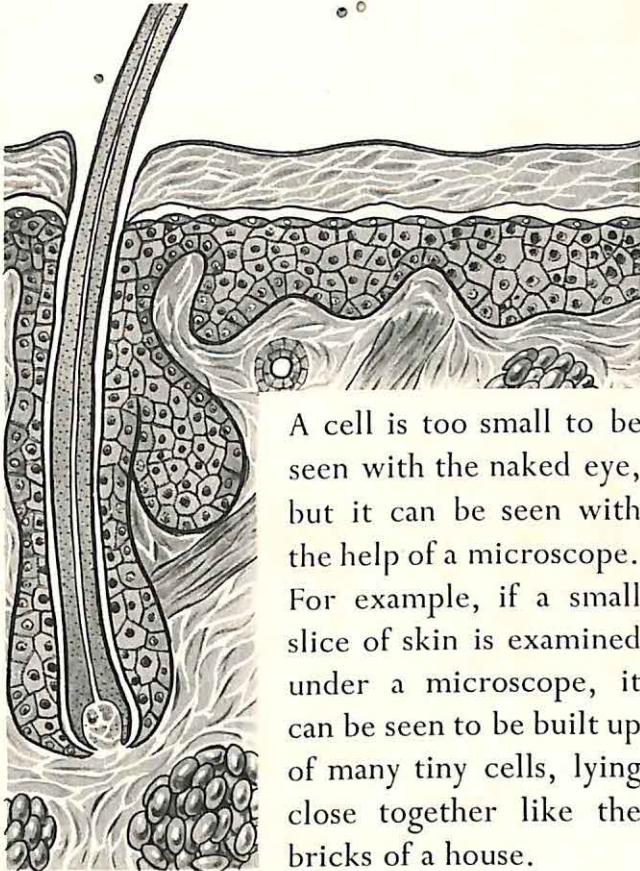
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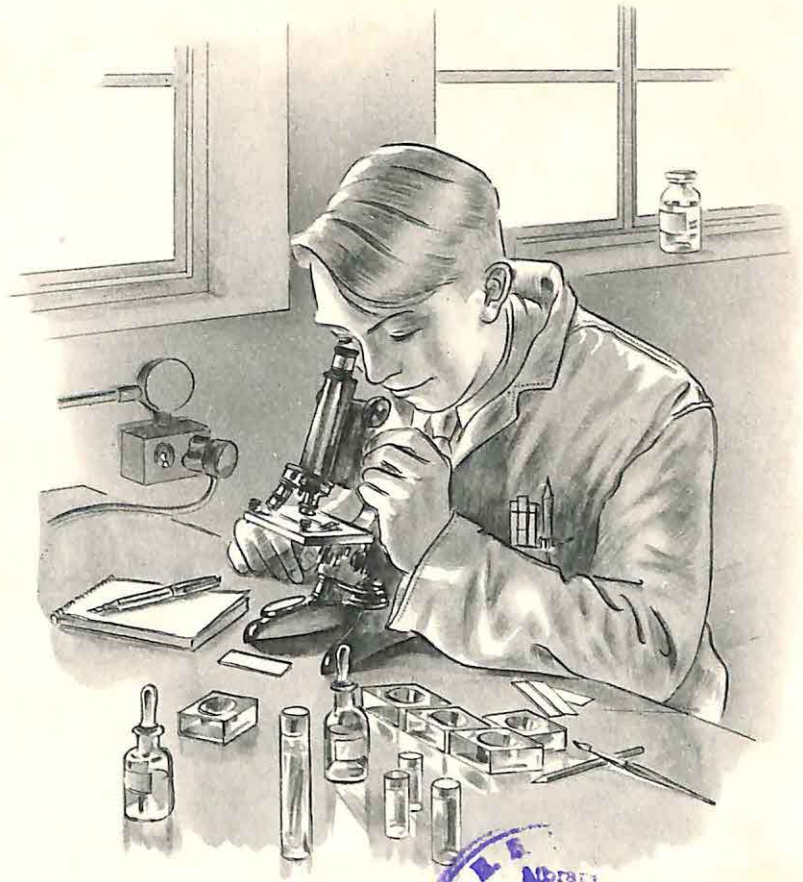
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The bricks you are made of

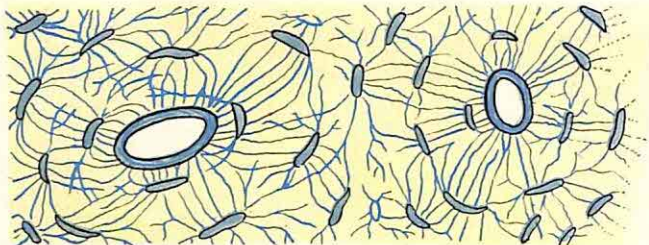
Everyone knows that houses are built of bricks. But did you know that *your body* is built of 'bricks' too? These 'bricks' that you are made of are called **CELLS** and in your body there are many millions of them.



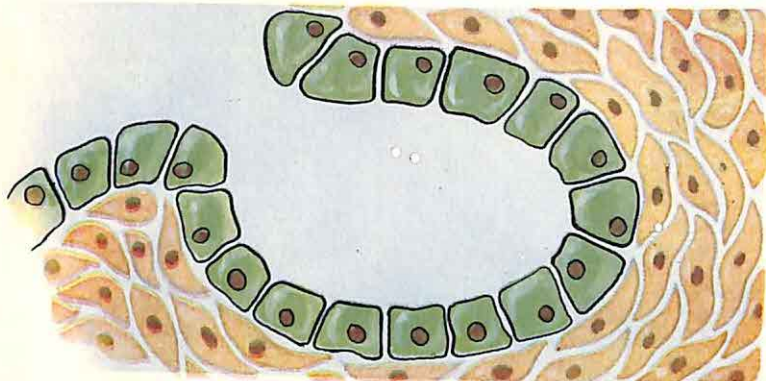
A cell is too small to be seen with the naked eye, but it can be seen with the help of a microscope. For example, if a small slice of skin is examined under a microscope, it can be seen to be built up of many tiny cells, lying close together like the bricks of a house.



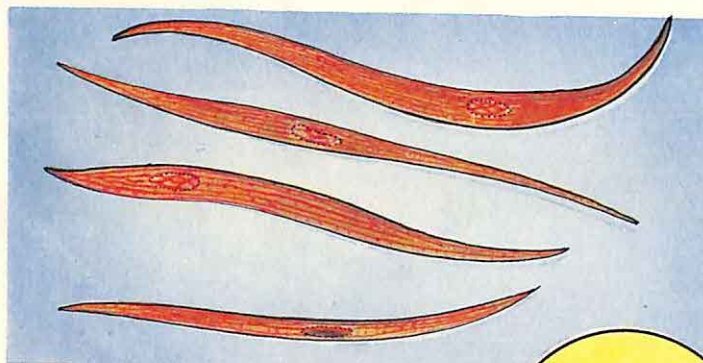
In your body there are many different sorts of cell, each sort doing a different job. These different types of cell cooperate to make the body work smoothly as a whole.



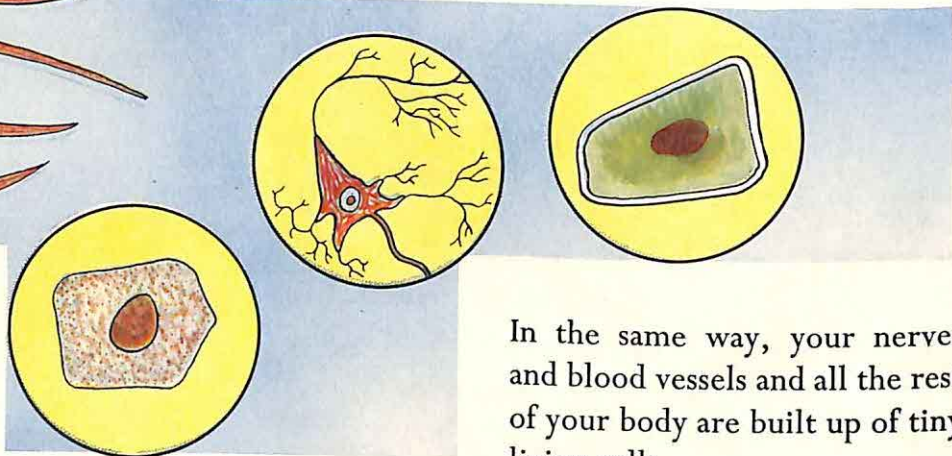
BONE CELLS form the hard substance that makes your bones so firm and strong.



GLAND CELLS make chemicals, which are used in digesting food and in many other ways.



MUSCLE CELLS become longer and shorter, and so move the arms and legs and all the other parts of the body.

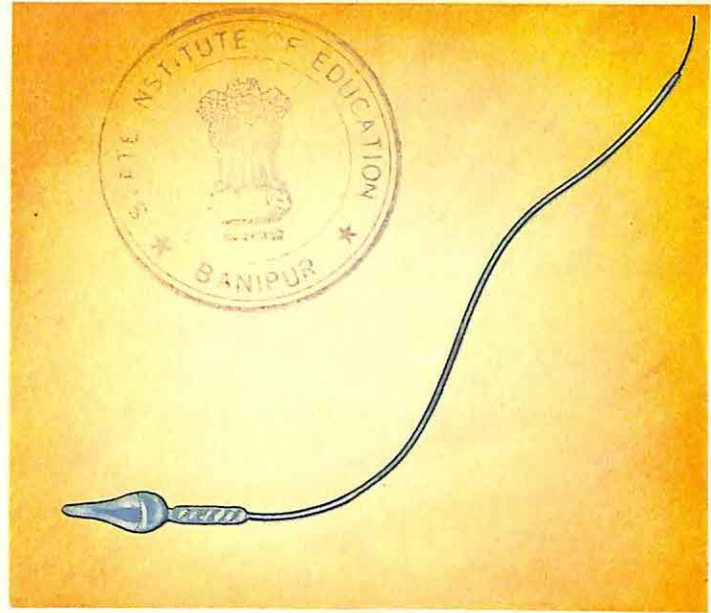
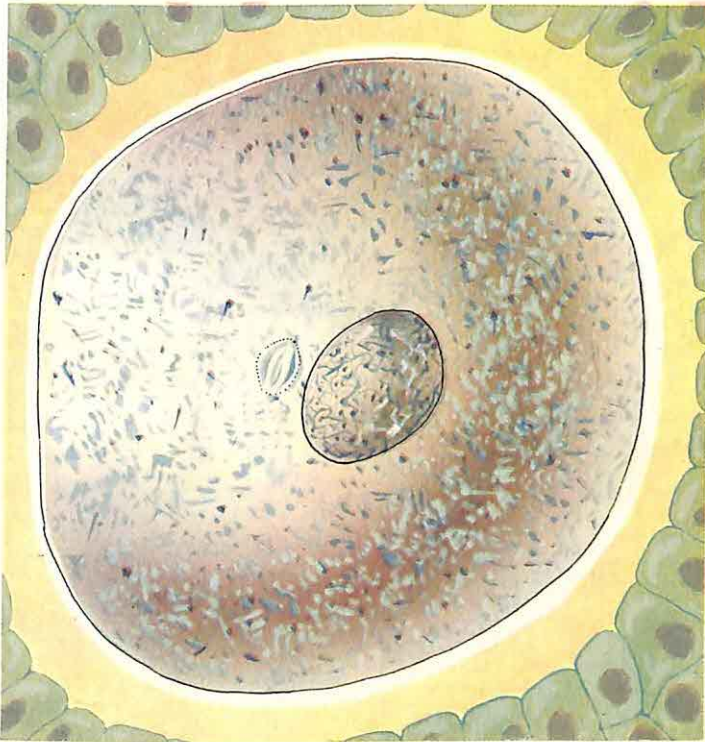


In the same way, your nerves and blood vessels and all the rest of your body are built up of tiny living cells.

How you began

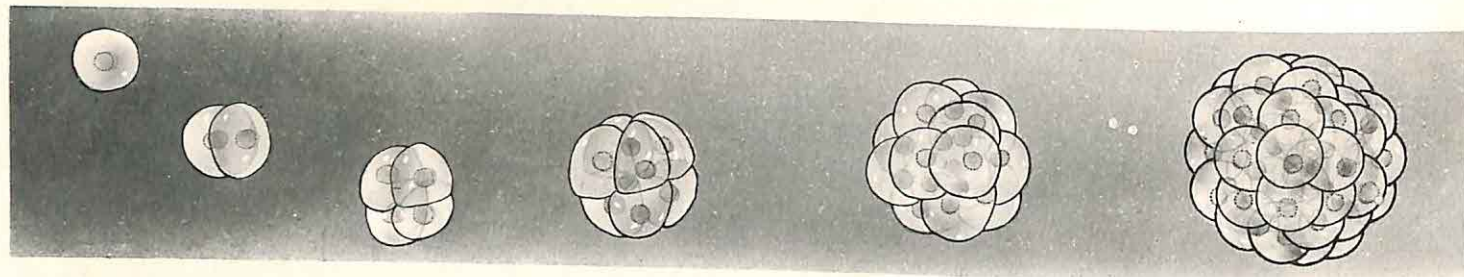
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Every one of us began life as a single cell called an 'egg' or OVUM. The human ovum is less than one-hundredth of an inch across – about the size of a very small grain of sand. Ova are made inside the mother's body.



An ovum will not begin to grow until it has been joined by another cell, called a SPERM. This sperm is much smaller than the ovum, and has a thin tail which makes it look rather like a tiny tadpole. Sperms are made inside the father's body. The joining together of the ovum and the sperm is called FERTILIZATION. The way in which fertilization takes place is described on page 30.

After the ovum has been fertilized by the sperm, it begins to grow. First it divides into two, then into four, eight, sixteen, thirty-two, and so on. Before very long it has grown into a little cluster of cells, looking rather like a mulberry.

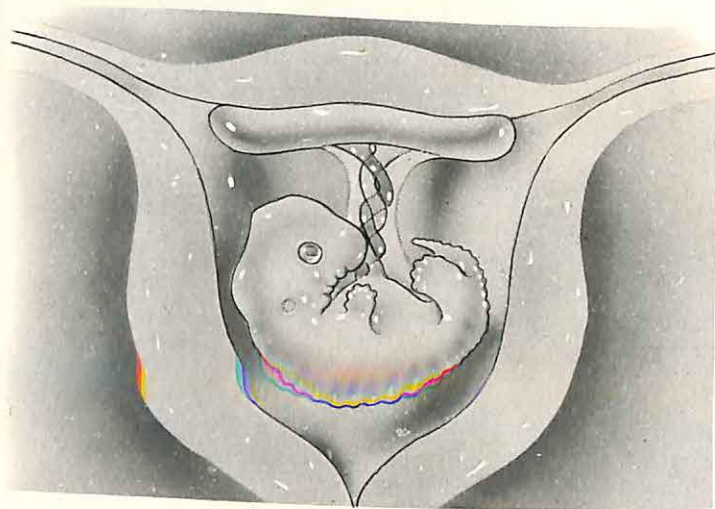


For nine months the fertilized egg grows inside the mother's body. It lives, warm and safe, in a special part called the 'womb' or UTERUS. Normally the womb is about the size and shape of an inverted pear, but it gets larger as the baby grows inside it. And, naturally, as the womb gets larger, the mother's tummy (the proper word is 'belly' or ABDOMEN) gets larger too.

While it is growing inside the mother, the baby gets its nourishment from its mother's blood. Instead of eating and breathing, the growing baby takes all it needs along a sort of tube called the NAVEL CORD.

When the baby is ready to be born, it leaves the mother's body through a special opening just between her legs.

The first thing the baby does is to cry out. This brings air into its lungs, and for *the rest of its life* it will go on breathing automatically, without having to give the matter a moment's thought.

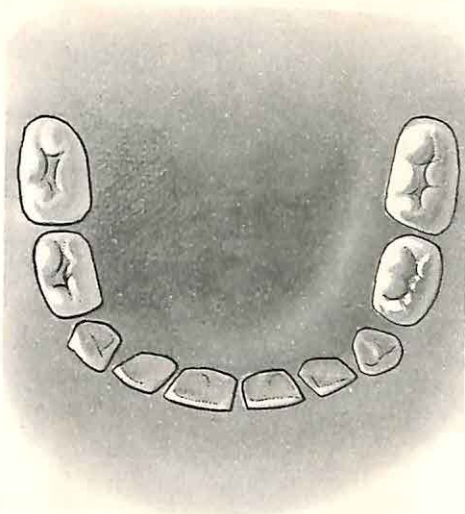
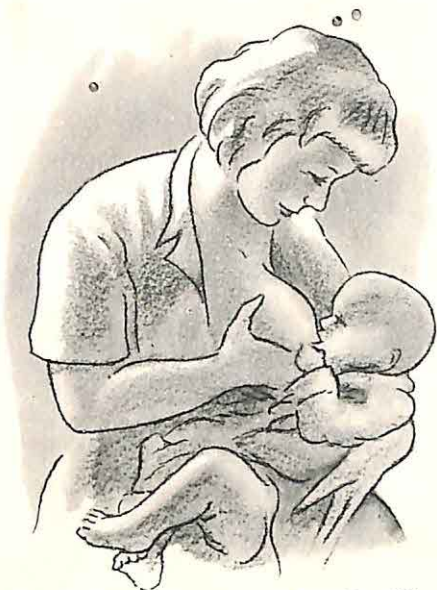


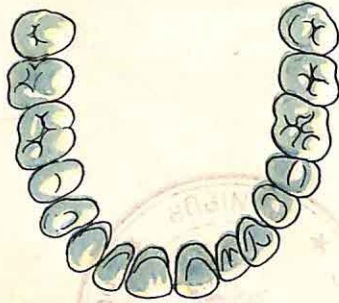
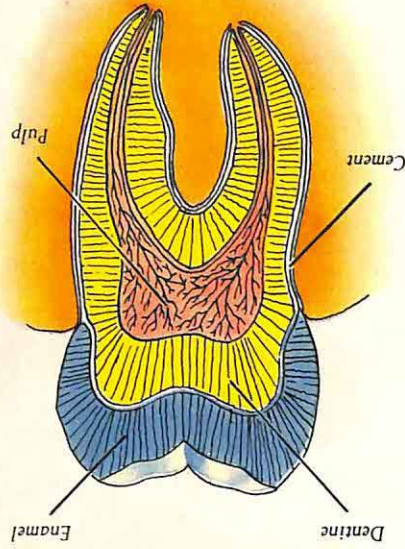
Once a baby is born, its whole way of life changes. Until now, its mother has been eating and breathing for it, but from now on it will eat and breathe for itself, so the navel cord is no longer necessary, and very soon after the birth the doctor or midwife cuts it off. This only takes a second and is not painful. The place where the navel cord used to enter the body is often called the 'belly button'. At first the baby does not need teeth, because it does not eat any solid food. It gets all the nourishment it needs from milk.

Usually the baby sucks its milk from its mother's breasts, but sometimes it is given cow's milk, either fresh or dried.

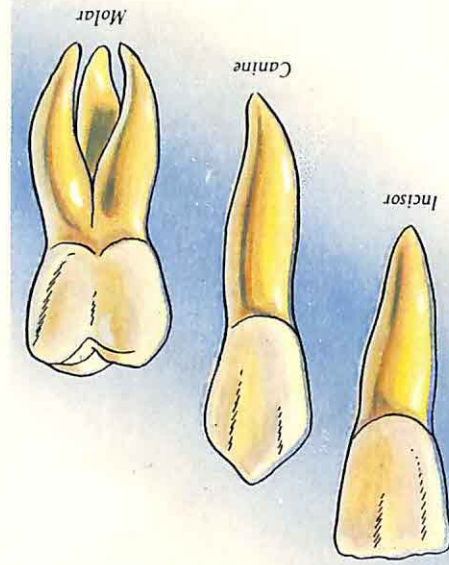
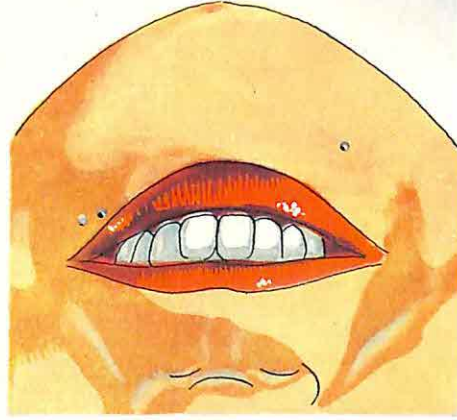
As the baby gets older, it gradually grows its first set of teeth (the MILK TEETH), and usually has all twenty by the time it is two to three years old. As its teeth come through, the baby is able to eat more and more solid food. All its life the baby will need food, either solid or liquid, for three reasons.

- First*, food is needed to build up the body as it grows larger, and to replace the millions of body cells when they wear out – just as materials are needed to enlarge a building and keep it in good repair.
- Second*, food is needed to provide the energy to move the body and keep it warm – just as coal is needed to move trains and warm houses.
- Third*, food is needed to keep the body working efficiently and protect it from disease – just as lubricating oil is needed to keep machinery working smoothly and prevent it from going rusty.





The first thing we do with food is to chew it. This breaks up the food into small pieces and mixes it with saliva, making it easier to swallow and digest. To chew well, we need good teeth. Our second set of teeth (the PERMANENT TEETH) consists of thirty-two, sixteen in each jaw. To keep them in good condition we need plenty of good food (especially milk), and to make them look pleasant we need to brush them regularly. We have three sorts of teeth: sharp 'cutting teeth' or INCISORS, pointed 'tearing teeth' or CANINES, and flat 'grinding teeth' or MOLARS. Each tooth has a soft centre or PULP; a hard layer called DENTINE; a very hard outer covering to the exposed part, called ENAMEL; and an outer layer to the root, called CEMENT.



You and your food

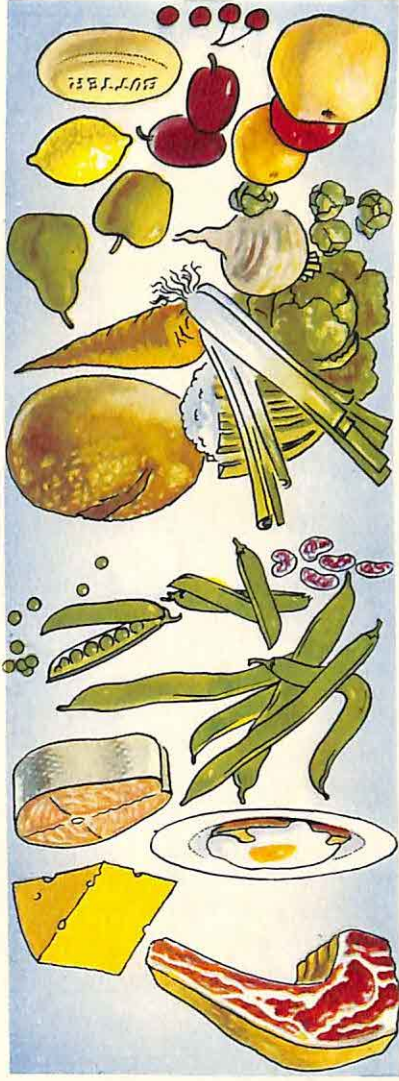
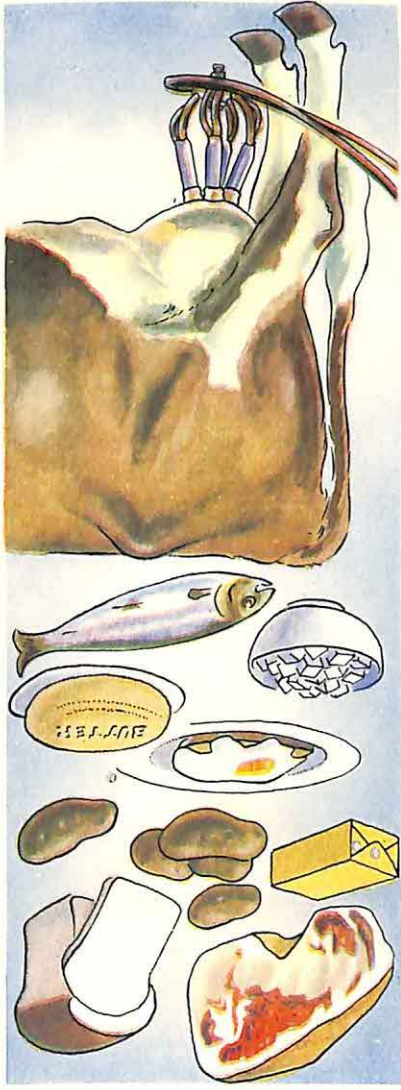
A balanced diet is needed to keep you in good health. This means that every day you should have some body-building foods, some energy foods, and some protective

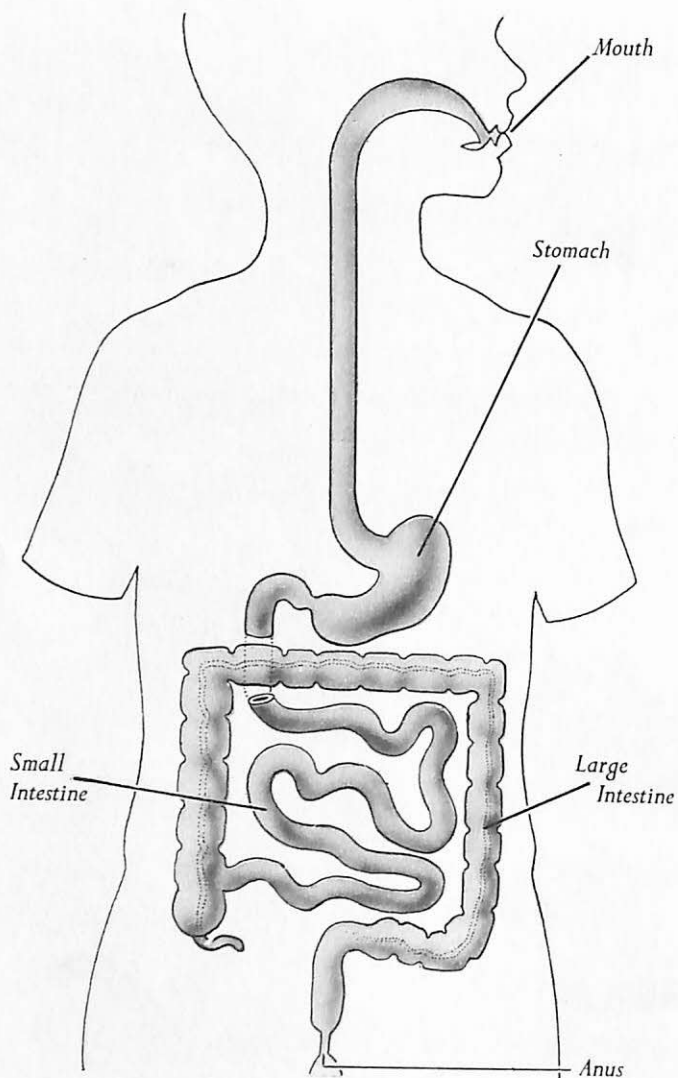
foods. *Good body-building foods* are lean meat, fish, cheese, the yolk and white of egg, and peas and beans. These contain chemicals called PROTEINS.

Good energy foods are bread, potatoes, sugar, butter and margarine, the yolk of egg, and fatty meat and fish. These foods contain either chemicals called CARBOHYDRATES (starches and sugars) or FATS.

Good protective foods are fresh vegetables, fresh fruit, animal fats, and wholemeal bread. These foods contain important chemicals called VITAMINS and also contain MINERAL SALTS.

The best food of all is milk. This contains proteins, carbohydrates, fats, vitamins, and mineral salts – so drink up all the milk you can get.





Once your food is chewed, it has to be broken down into simpler chemicals which the body can absorb and use. This breaking down is called **DIGESTION**, and is carried out by liquids known as **DIGESTIVE JUICES**.

In the mouth, carbohydrates are partly digested by the saliva, which is a digestive juice. The food is then swallowed, and passes down the gullet into the **STOMACH**.

In the stomach, another digestive juice starts to digest proteins. After a while, the food (which is now a semi-liquid 'paste') passes into a long, thin tube called the **SMALL INTESTINE**.

In the small intestine, other digestive juices complete the break-down of the carbohydrates and proteins, and also digest the fats. The digested food is then absorbed through the wall of the small intestine, and is carried by the blood-stream to every part of the body. The watery liquid left then passes into a wider tube, called the **LARGE INTESTINE**.

In the large intestine, water is absorbed by the intestine walls, so the liquid becomes less watery and changes into a semi-solid. This semi-solid waste material is passed out of the body through an opening known as the **ANUS**.

What happens when you move

The body is built around a framework of bones, called the **SKELETON**. When a baby is first born, the bones are still soft; but as the child grows older, the bones get harder.

The skull, which is a hollow box made up of several bones, protects the brain from injury.

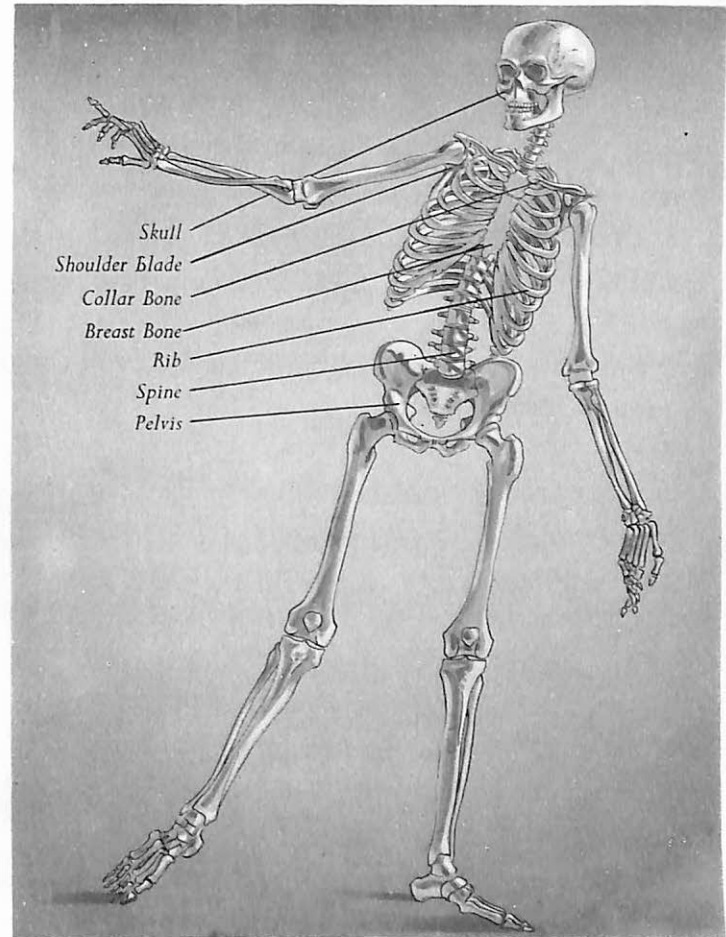
The spine, which is made mainly of 'rings' of bone, protects the spinal cord.

The ribs (twelve pairs of them) are jointed to the spine, and form a 'cage' which protects the heart and lungs.

The breast bone is at the front of the ribs, and is jointed to the two *collar bones*. The collar bones are jointed to the two *shoulder blades* and the shoulder blades to the upper bones of the arms.

The pelvis is at the lower end of the spine, and is jointed to the upper bones of the legs.

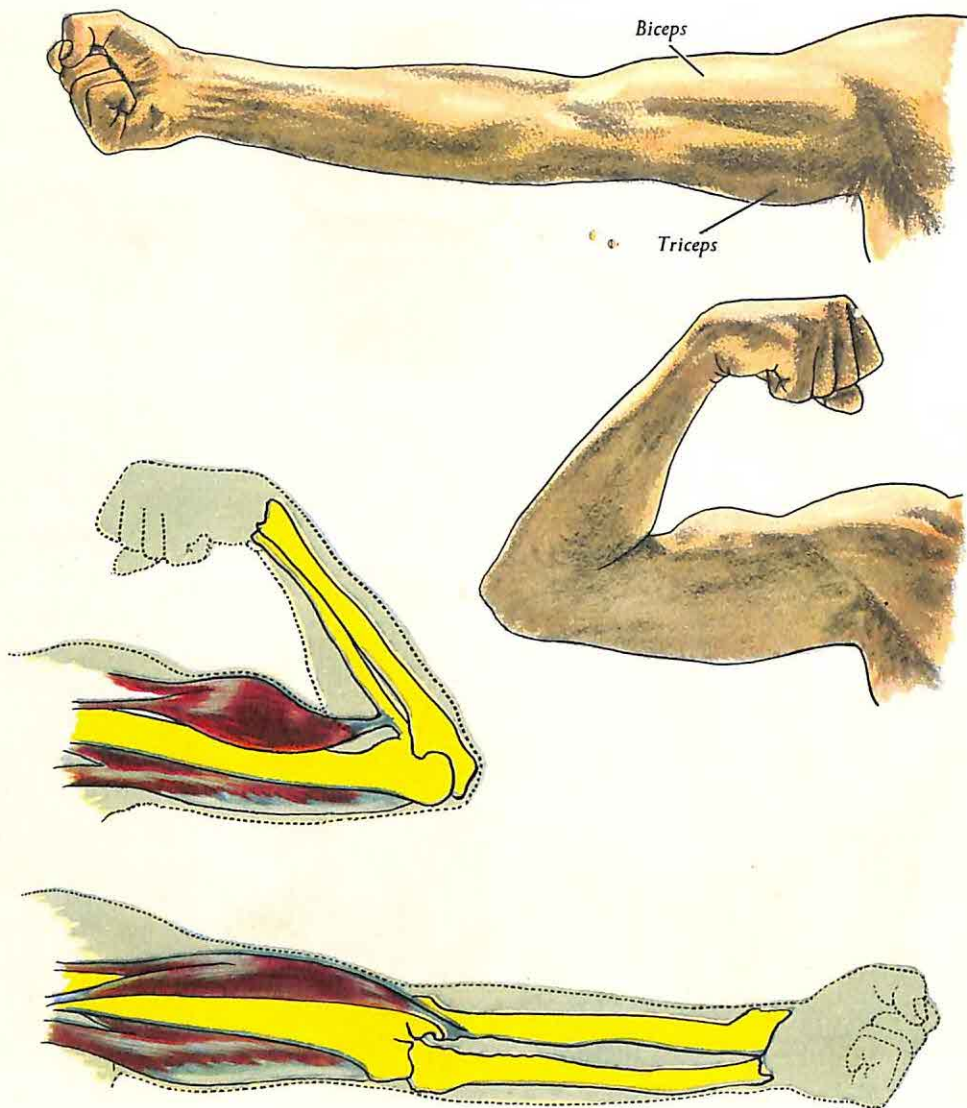
There is one main bone in each upper arm and thigh, two bones in each forearm and lower leg, a group of bones in each ankle and wrist, other bones in the palm of the hand and the sole of the foot, and yet others in the fingers and toes.

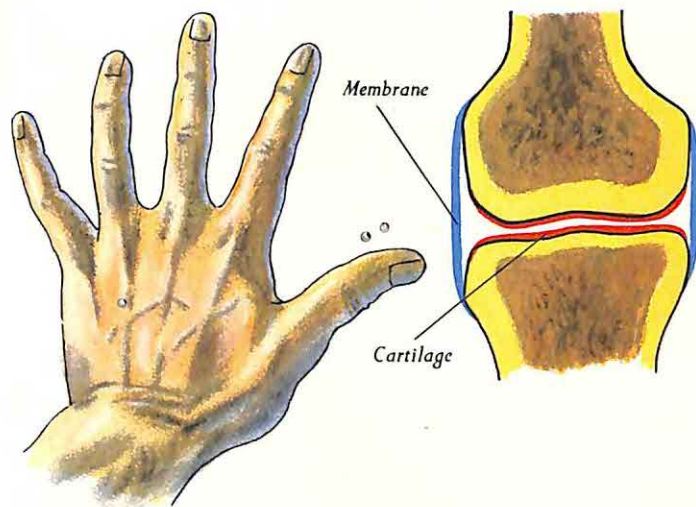


The bones are moved by means of **MUSCLES**, which make up most of the flesh.

To bend the arm, we shorten a muscle called the **BICEPS** and lengthen a muscle called the **TRICEPS**. You may be able to see or feel your biceps muscle moving when you bend your arm. To straighten the arm, we lengthen the biceps and shorten the triceps. Every movement we make depends on this sort of co-operation between two or more muscles.

It is the movement of muscles that makes a smile or a scowl, that winks your eye or screws up your nose. Even while you are asleep, many muscles in your body are moving. Your whole life long, the muscles that make you breathe and those that make your heart beat are continually moving day and night.

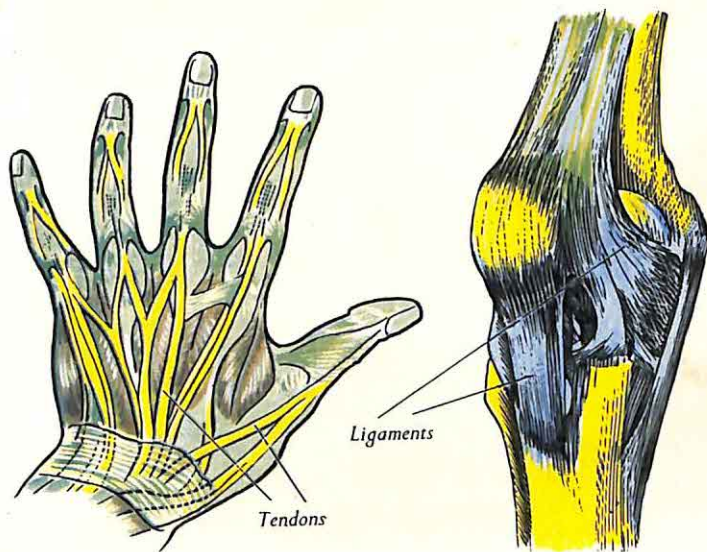


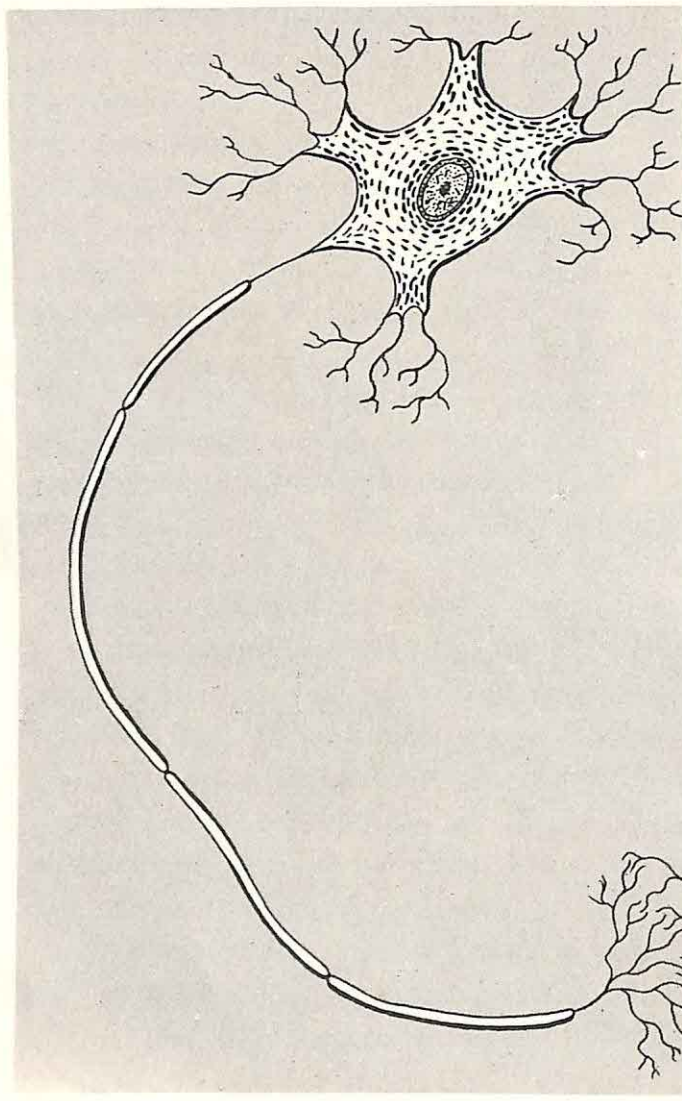


If you wiggle your fingers as if you were playing the piano, you will see 'cords' moving under the skin on the back of your hand. These 'cords' are called **TENDONS** and they join the muscles to the bones. When a muscle contracts, it pulls on the tendon and the tendon pulls on the bone. Next Christmas ask for the foot of the turkey or goose, and you will be able to see just how the tendons work.

At the joints, bones are held together by tough fibrous bands known as **LIGAMENTS**. Where the bones move over each other, they are covered with a soft pad of 'gristle' or **CARTILAGE**. The joint is surrounded by a sort of bag, or **MEMBRANE**, which produces a liquid that lubricates the joints.

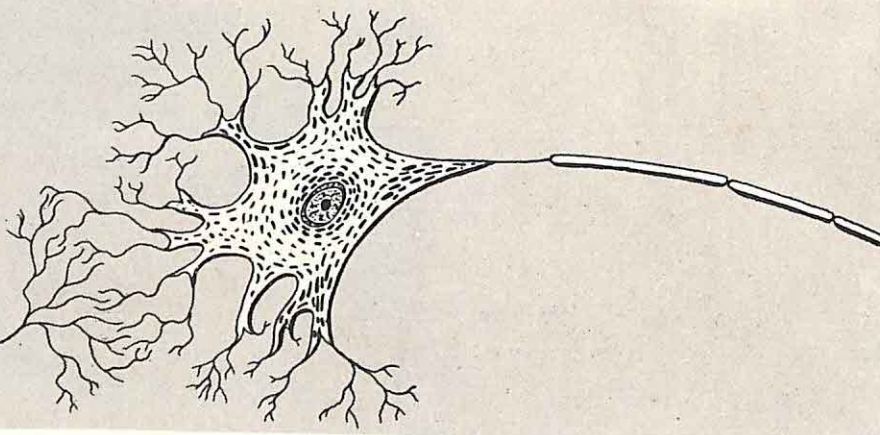
As you can see, movement is a very complicated thing. Each muscle has to be shortened or lengthened at just the right moment, and by just the right amount. If the cricketer's muscles do not move just right, he will be bowled out instead of hitting a boundary. If the motorist's muscles do not move quickly enough when he puts the brake on, he may run over somebody. If muscles all over your body did not contract or stretch in harmony with each other, you could not even stand up.

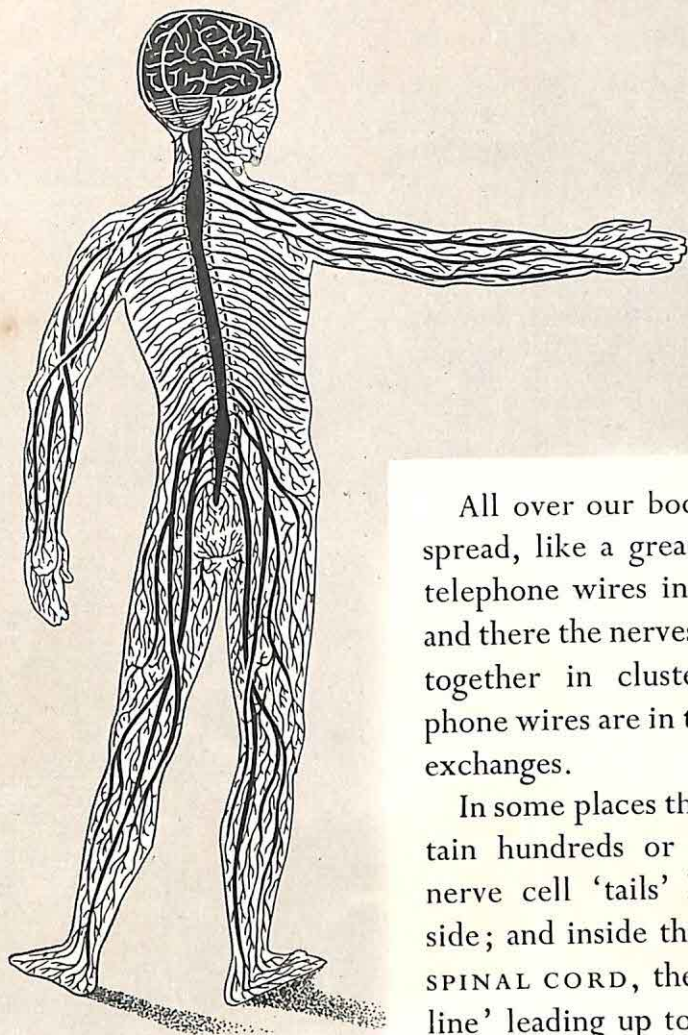




The movement of the muscles is controlled by NERVES. Nerve cells have long, thin 'tails', and the 'tail' of one nerve cell is in contact with the 'head' of another. Electric messages pass along from one nerve cell to the next, and so travel from head to foot in a fraction of a second. That is how it is that we are able to move out of the way so quickly if something is thrown at us.

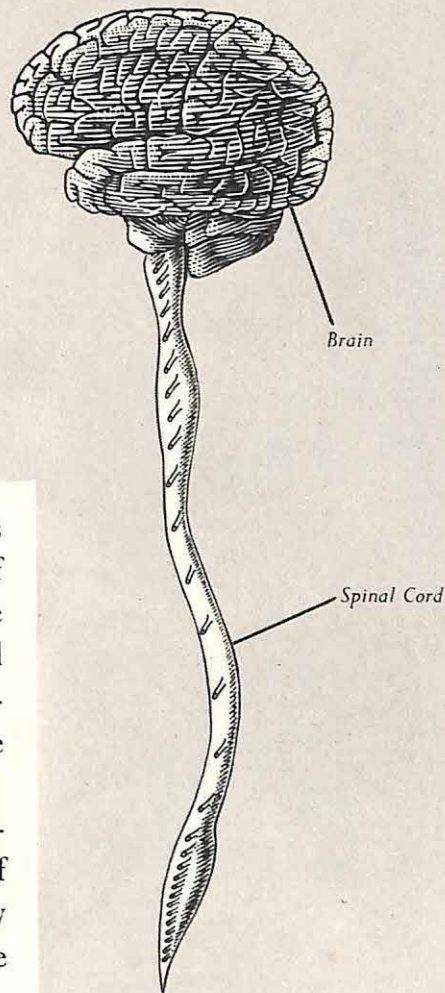
Many of the nervous messages take place without our knowing anything about it. For example, some nervous messages control the amount of digestive juices set free when we have a meal, others open the pupils of our eyes more widely when the light grows dim, and so on.



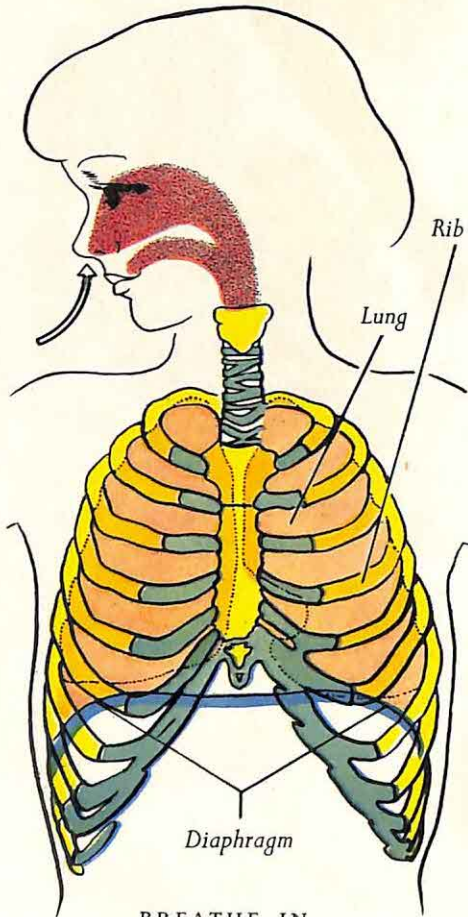


All over our body the nerves spread, like a great network of telephone wires in a city. Here and there the nerves are gathered together in clusters, as telephone wires are in the telephone exchanges.

In some places the nerves contain hundreds or thousands of nerve cell 'tails' lying side by side; and inside the spine is the SPINAL CORD, the main 'trunk line' leading up to the brain.



What happens when you breathe

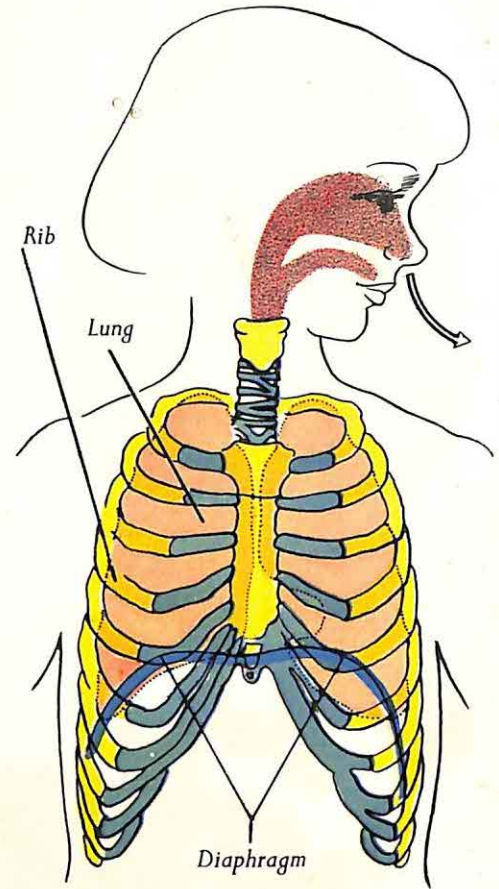


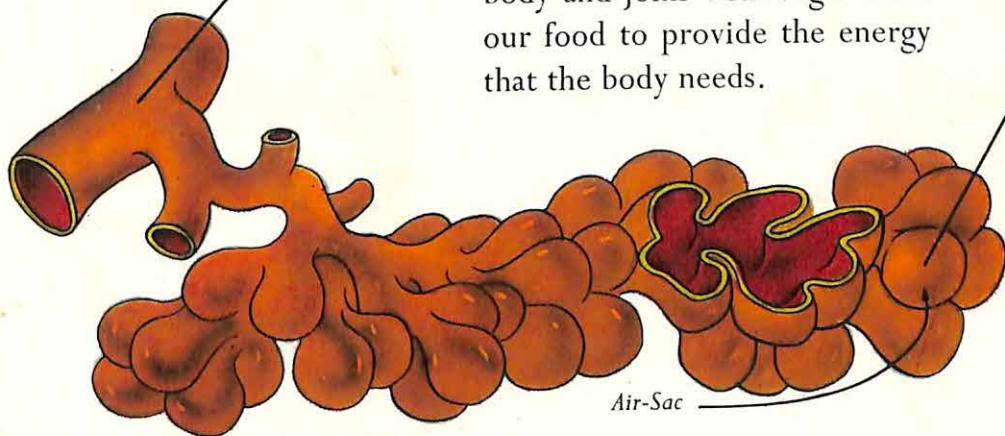
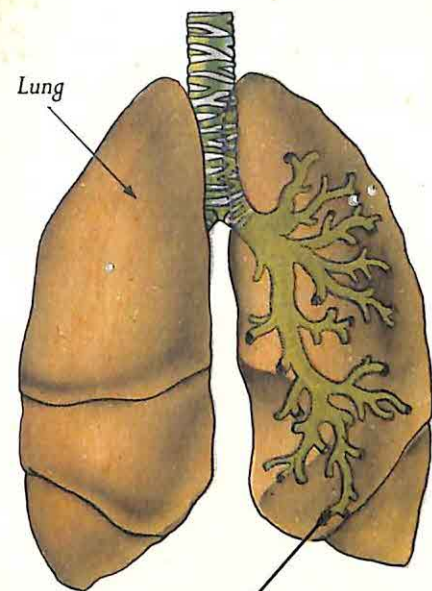
If you breathe in deeply, you can feel your chest expanding as your LUNGS fill with air. The space in which the lungs lie is made larger in two ways.

The RIBS are raised upwards and outwards, and at the same time the DIAPHRAGM (which is a sheet of muscle lying across the body below the lungs) is lowered. As the space in which the lungs lie gets larger, air passes into the lungs.

When you breathe out, the opposite happens. The ribs are moved downwards and inwards, and the diaphragm is moved upwards. Thus the space in which the lungs lie is made smaller, and the air passes out of the lungs.

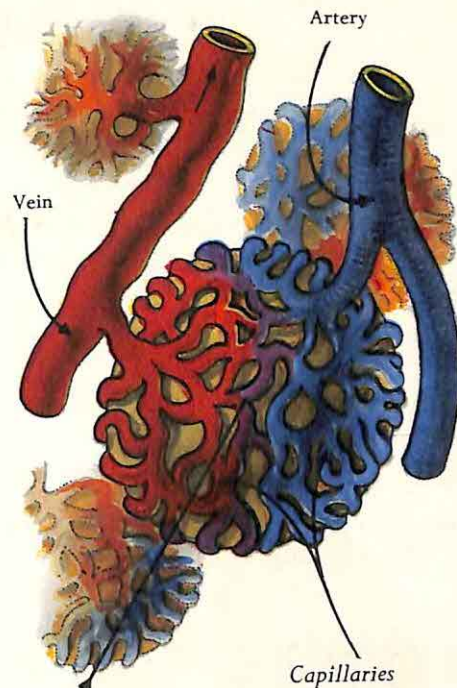
It is good to get into the habit of breathing deeply.





The lungs contain millions of very tiny AIR-SACS, connected by tubes to the windpipe, and so out through the nose to the atmosphere. In the wall of each air-sac is a network of tiny blood vessels called CAPILLARIES. You will find more about capillaries on page 21.

As the blood passes through these blood vessels, OXYGEN from the air seeps through the blood vessel walls into the blood. The oxygen is carried by the bloodstream to all parts of the body and joins with sugar from our food to provide the energy that the body needs.

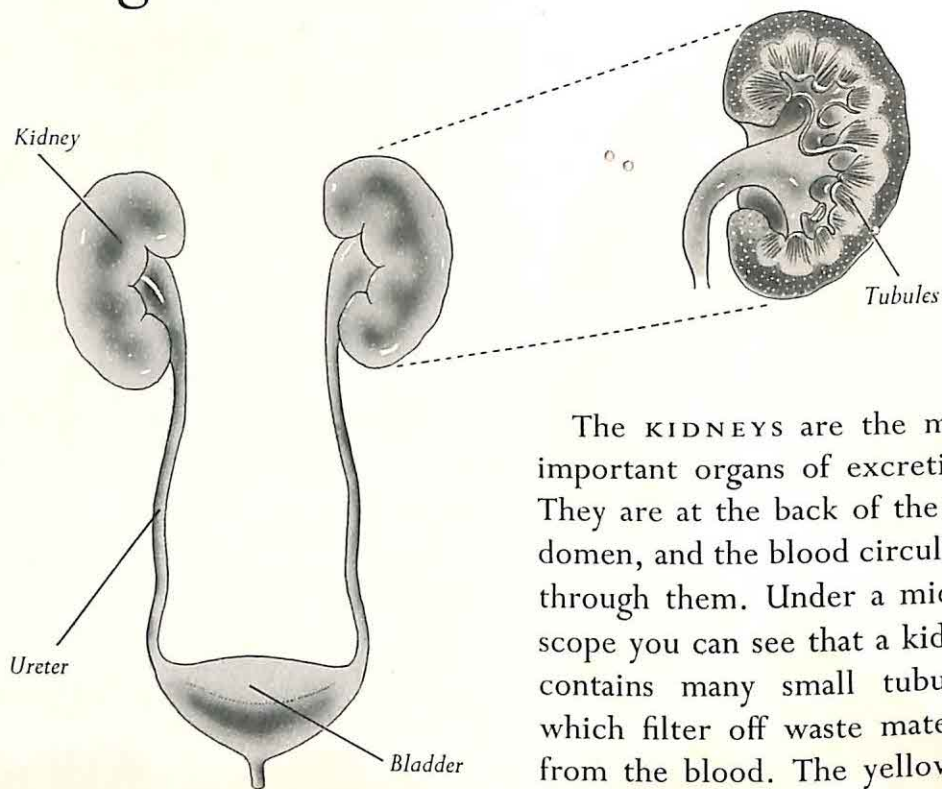
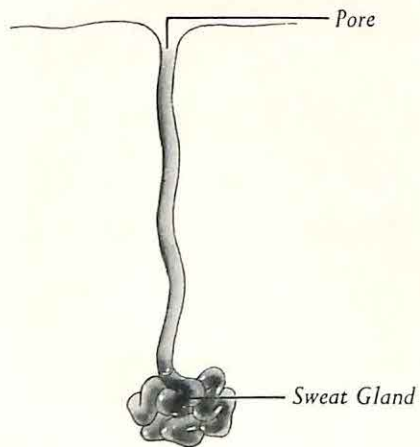


All the time the cells of the body are producing a waste material called CARBON DIOXIDE. This is carried by the blood to the lungs, and passes out of the tiny blood vessels at the same time as the oxygen is passing in.

Getting rid of waste

The body produces other waste materials, as well as carbon dioxide. The waste is got rid of in various ways. This process of getting rid of waste material is called **EXCRETION**.

SWEAT GLANDS in the skin get rid of some waste. They are coiled tubes which produce the sweat, and the sweat leaves the body through little openings in

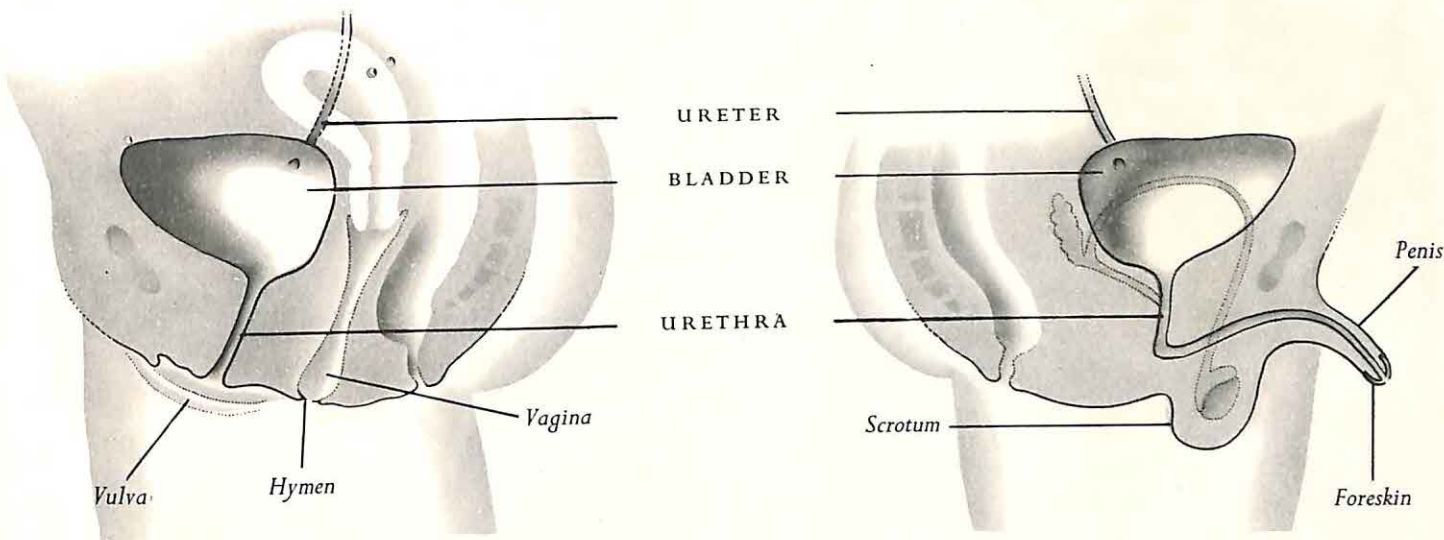


the skin called **PORES**. You can see the pores if you look at the palm of your hand with a magnifying glass.

The **KIDNEYS** are the most important organs of excretion. They are at the back of the abdomen, and the blood circulates through them. Under a microscope you can see that a kidney contains many small tubules, which filter off waste material from the blood. The yellowish liquid containing this waste material is called **URINE**.

The urine passes down two tubes called **URETER** to a bag called the **BLADDER**, where it is stored until it leaves the body.

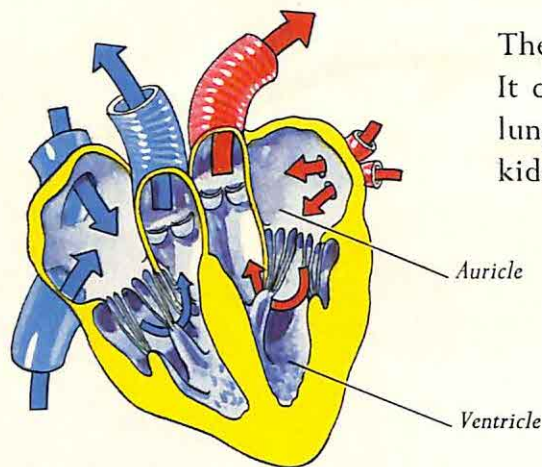
In both boys and girls, the urine leaves the bladder along a tube called the URETHRA. Normally, the urethra is kept closed by a ring of muscle below the bladder; but when the bladder gets full, this muscle relaxes and allows the urine to flow out.



In the case of a girl the urethra opens to the outside of the body between the legs. Just behind the urine-opening is the VAGINA, which is the passage through which a baby is born, and which is closed by a thin membrane known as the HYMEN. Around these two openings are folds or 'lips' of flesh, which form what is called the VULVA.

In the case of a boy, the urethra passes through a fleshy tube called the PENIS, which hangs between the legs. At the tip of the penis is a fold of skin, the FORESKIN, which can be drawn back. Sometimes the foreskin is removed soon after birth (this little operation is called 'circumcision'). Just behind and below the penis is a pouch, called the SCROTUM.

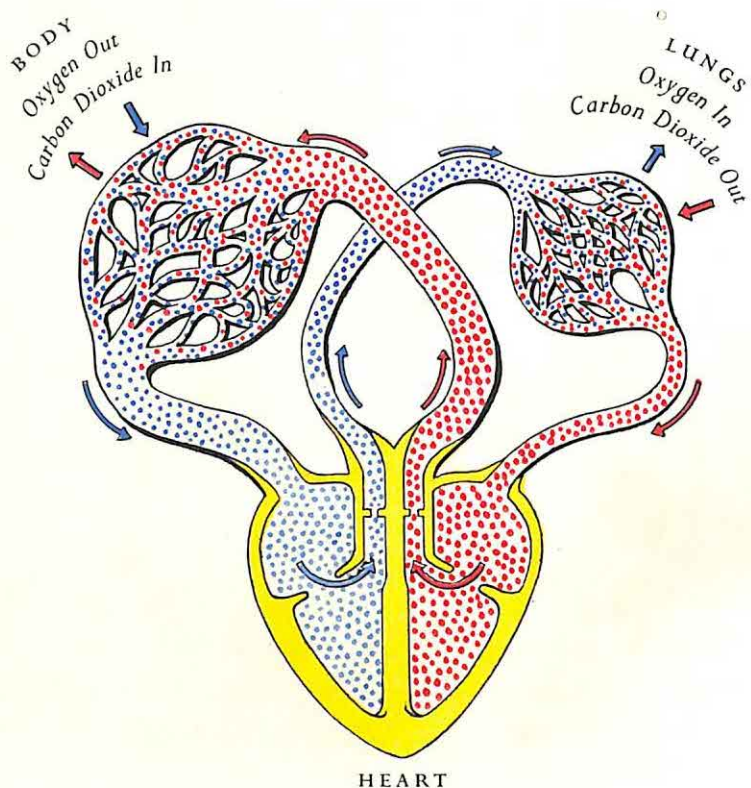
Your blood system



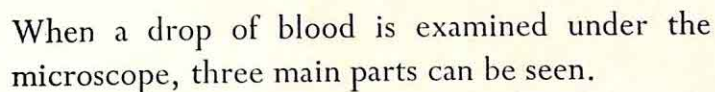
The blood has already been mentioned several times in this book. It carries digested food round the body, carries oxygen from the lungs and carbon dioxide to them, and carries waste material to the kidneys. The blood circulation is the body's transport system.

The blood is forced round the body by the **HEART**, which is a powerful pump, with thick muscular walls. The heart is divided into right and left sides, and each side has an upper chamber called an **AURICLE** and a lower chamber called a **VENTRICLE**.

From the left ventricle, the blood is pumped to most of the body, and returns to the right auricle. It then passes down into the right ventricle, and is pumped to the lungs. From the lungs it returns to the left auricle, passes down into the left ventricle, and starts the journey all over again.



A diagram illustrating the flow of blood through a tissue bed. A red artery on the left carries blood into the tissue, indicated by red arrows. The blood then flows through a network of red capillaries. From the capillaries, a blue vein carries the blood away from the tissue, indicated by blue arrows. The tissue itself is shown as a light-colored, irregular shape with dashed lines representing internal structure.



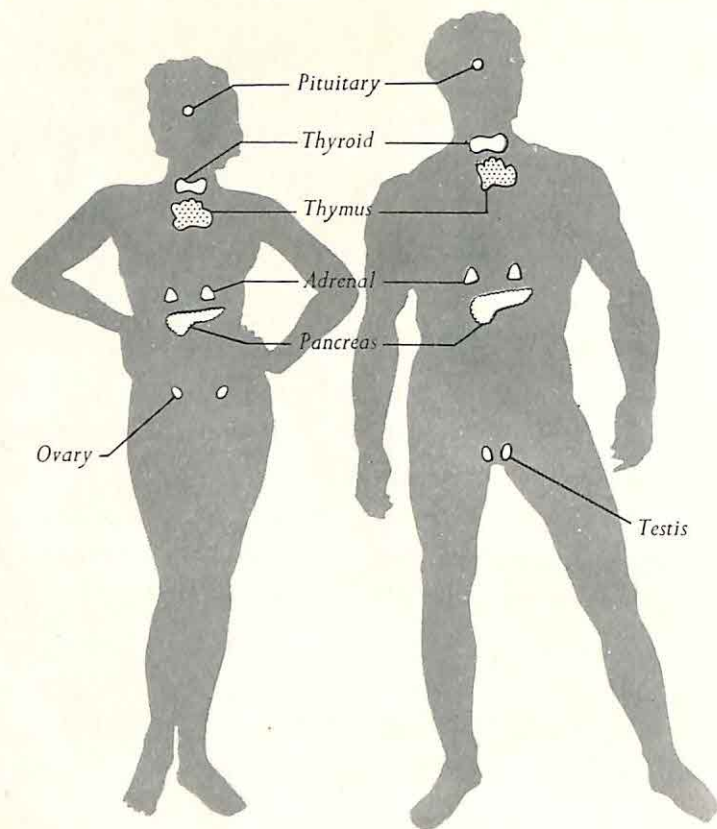
There is a very large number of RED CORPUSCLES, which are small disc-shaped cells. These contain a purplish-red colouring matter called 'haemoglobin', which carries oxygen from the lungs to the rest of the body.

For about every 500 red corpuscles there is one WHITE CORPUSCLE, which is rather larger and almost colourless. These white corpuscles attack disease germs and also manufacture chemicals called 'antibodies' which help to protect us from disease.

The red and white corpuscles float in a pale straw-coloured liquid called PLASMA. This plasma carries dissolved foodstuffs, waste substances, and other chemicals, around the body.

Chemical messengers

Dissolved in the blood there are also chemicals called **HORMONES**, which are produced by glands in various parts of the body. The position of these glands is shown in the diagram.



Just as nerves provide a sort of 'telegraphic system' for the body, the hormones provide a slower means of communication – a sort of 'postal delivery'. The hormones, travelling round the body in the blood, act as chemical messengers.

The **PANCREAS**, near the stomach, makes a hormone which controls the use of sugar in the body.

The **ADRENAL** glands, near the kidneys, make a hormone which speeds up the heart beat and prepares the body for vigorous action.

The **THYMUS** gland, above the heart, regulates growth during the early years of life. It gradually disappears as we grow older.

The **THYROID** gland, in the neck, makes a hormone which increases the release of energy in the body cells.

The **PITUITARY** gland, just below the brain, is especially important and makes many different hormones. These influence bodily growth and help to bring about the change from child to adult.

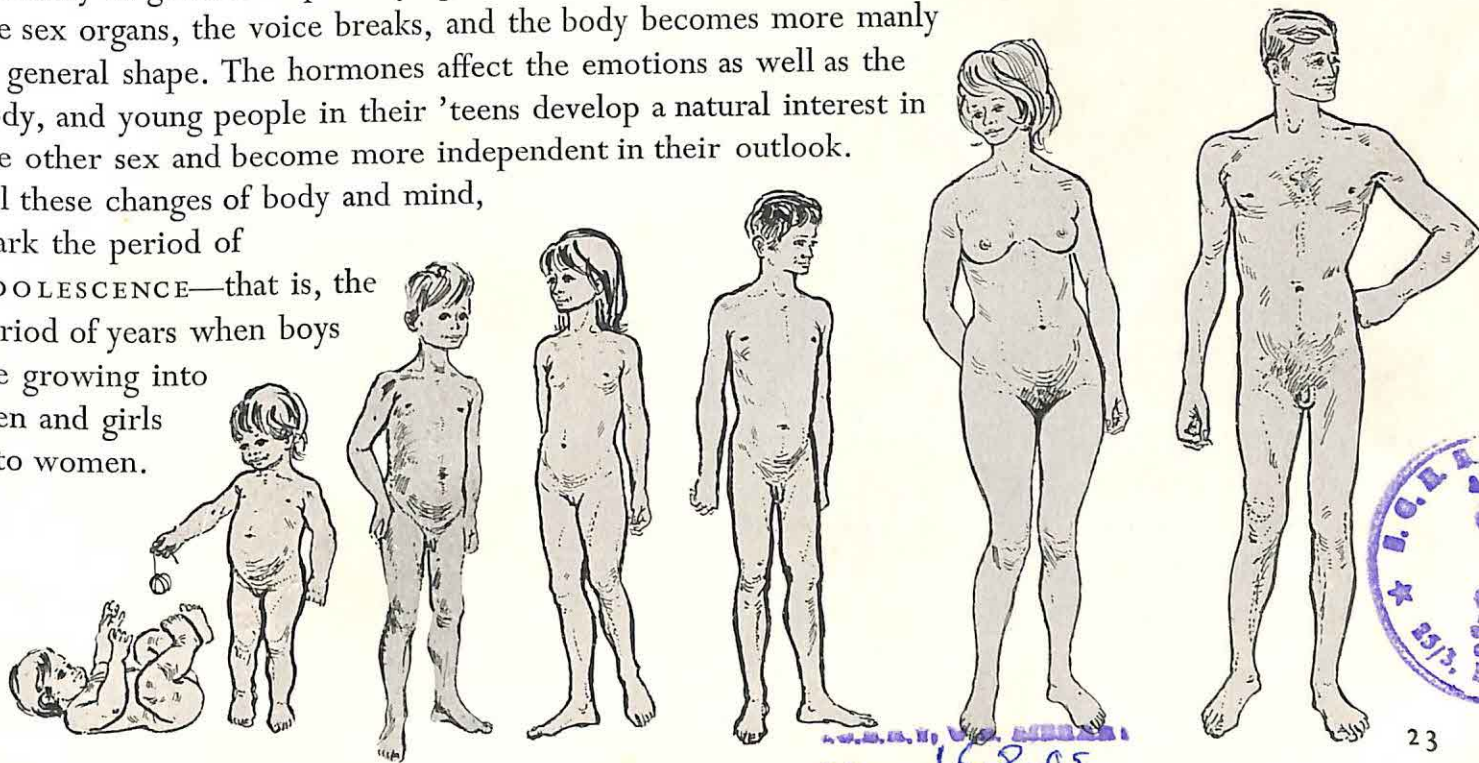
The different hormones act in harmony together, and help the nerves to keep the body working smoothly.

Glands and growing up

All these glands are present in both girls and boys, but there are other glands called 'sex glands', which are different in the two sexes. The sex glands of girls are called OVARIES, while those of boys are called TESTES. The sex glands become very active around the age of eleven or twelve years in girls, and a year or two later in boys. The hormones they produce pass out into the blood stream and are carried all round the body. As a result of the action of these hormones, many important changes take place. Girls grow hair under the armpits and around the sex organs, their breasts develop, and their bodies become more womanly in general shape. Boys grow hair on the face and chest as well as under the armpits and around the sex organs, the voice breaks, and the body becomes more manly in general shape. The hormones affect the emotions as well as the body, and young people in their 'teens develop a natural interest in the other sex and become more independent in their outlook.

All these changes of body and mind,

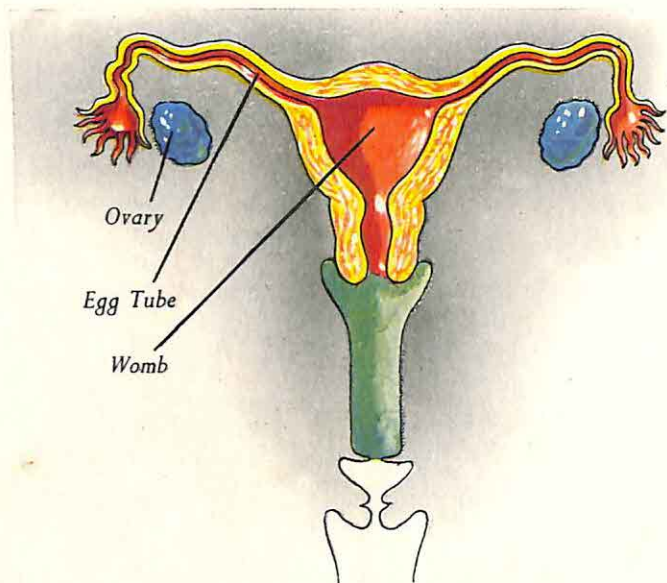
mark the period of ADOLESCENCE—that is, the period of years when boys are growing into men and girls into women.



40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100
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The most striking of the changes that take place during adolescence is the 'growing up' of the sex organs.

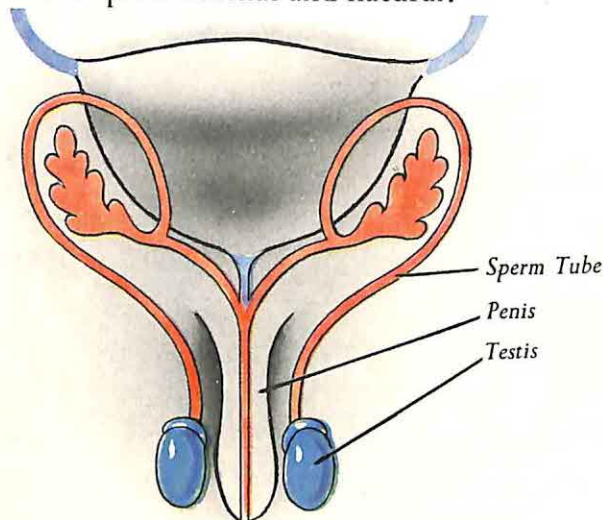


The boy has two TESTES, which are small, ball-shaped bodies lying in the scrotum between the legs. They produce millions of minute sperms, which are stored in a liquid called SEMEN.

Every so often, the semen may pass along the two SPERM TUBES, and leave the body through the penis. This occasional loss of semen is a perfectly natural thing, and should cause no worry when it happens.

The girl has two OVARIES, which are soft, walnut-shaped bodies lying in the abdomen, one on each side. They produce ova, one ovum being set free about every 28 days, and passing down the EGG TUBE.

Similarly, every 28 days the delicate lining of the womb is renewed. The old lining breaks down and leaves the body through the vagina. This monthly flow of old cells and blood is called MENSTRUATION and is quite normal and natural.



Your 'five senses'

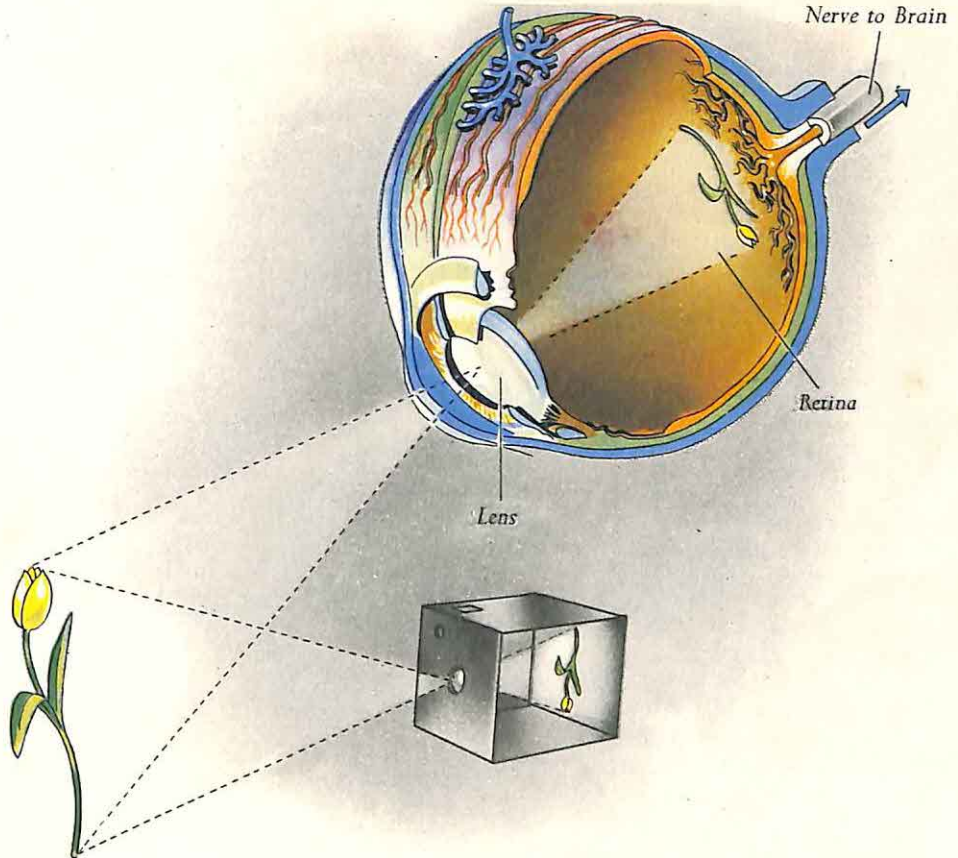
Actually we have more than five senses, but the most important are these – the sense of sight, the sense of sound, the sense of touch, the sense of taste, and the sense of smell.

The eye is rather like a camera, but is much more complicated.

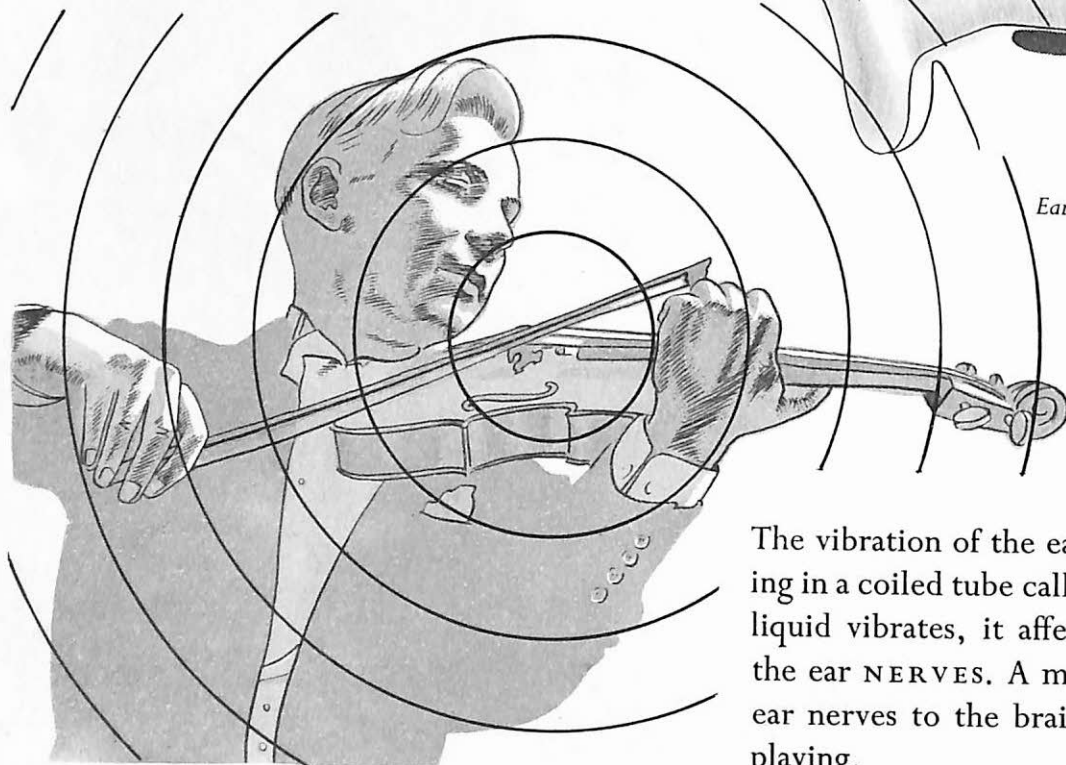
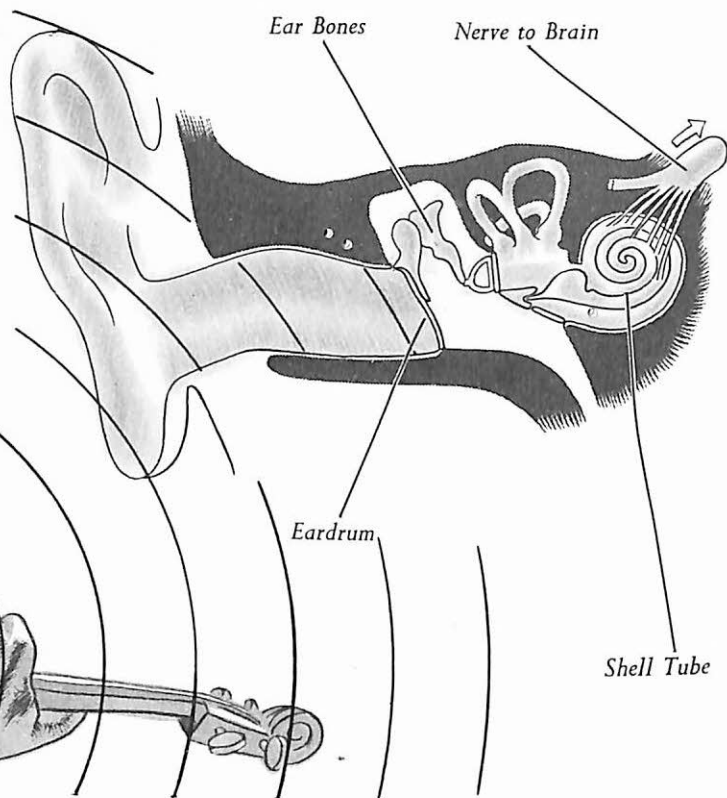
The light rays from a tulip go to the camera, and are focused by the lens on to the film. At the back of the camera an image of the tulip is thus formed on the film and may be developed and printed.

Similarly the light rays from the tulip go to the eye. The LENS of the eye focuses the light on the RETINA, a thin layer at the back of the eye. An image of the tulip is thus formed on the retina.

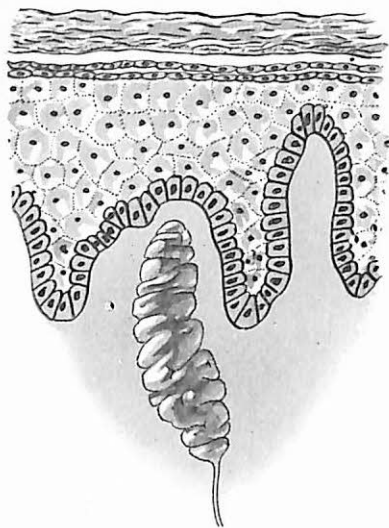
The NERVES of the eye send a message to the BRAIN, and we 'see' the tulip.



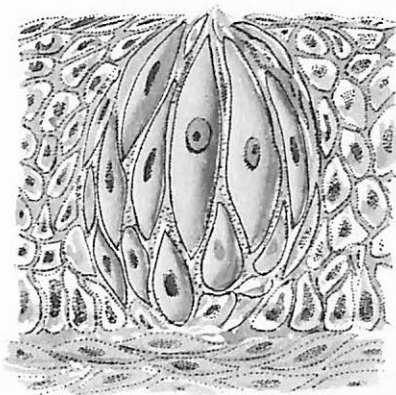
Have you ever wondered how you hear things? When a violin is played, sound waves from the violin pass through the air to the ear. The sound waves pass into the ear, and make the **EARDRUM** vibrate. (The eardrum is stretched tightly, like a drum skin). The vibrating eardrum makes three little **EAR BONES** vibrate in unison.



The vibration of the ear bones sets a liquid vibrating in a coiled tube called the **SHELL TUBE**. As this liquid vibrates, it affects the sensitive endings of the ear **NERVES**. A message then passes along the ear nerves to the brain, and we 'hear' the violin playing.



In the skin there are sensitive nerve endings which tell us when we are touching things. If a slice of skin is examined under the microscope, these 'touch nerves' may be seen just below the surface.



On the tongue there are little lumps or 'buds' which carry the nerve endings that are sensitive to taste. Some buds taste sweet things, some taste sour, some taste bitter, and some taste salt things.

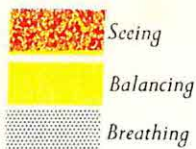
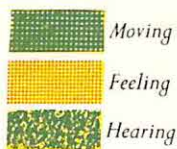
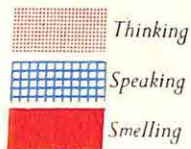
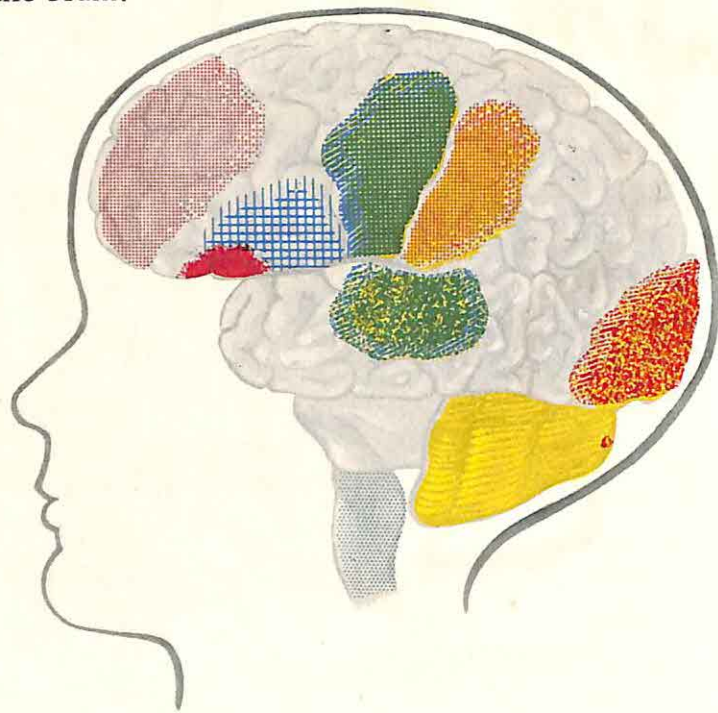


In the nose there are nerve endings which are sensitive to smell. The delicate perfume of the rose, the faint scent of the lime, the foul odours of a gas works – all these we know of because of our sense of smell.

In addition to these five senses, we have many others. Nerve endings hidden in the joints tell us of the positions of our limbs. Others tell us when we are hungry or thirsty, or hot or cold. Others help us to keep our balance. All day and all night, our nerve endings are pouring in messages to the brain, telling it about the state of the body and the world outside.

Working in harmony

The body is so complicated and has to do so many different things that all its parts and all its actions need to be kept working in harmony. The part of the body that does most to keep things working smoothly is the brain.



In the brain there are about 12,000,000 nerve cells. We do not know exactly how the brain works, but every year we are learning more and more about it.

We know that messages pour into the brain along the nerves of the spinal cord. These messages come from the eyes, ears, mouth, nose, skin, and all the other parts of the body. The brain sorts out these messages, decides what should be done about them, and sends out other messages along nerves to muscles and glands all over the body.

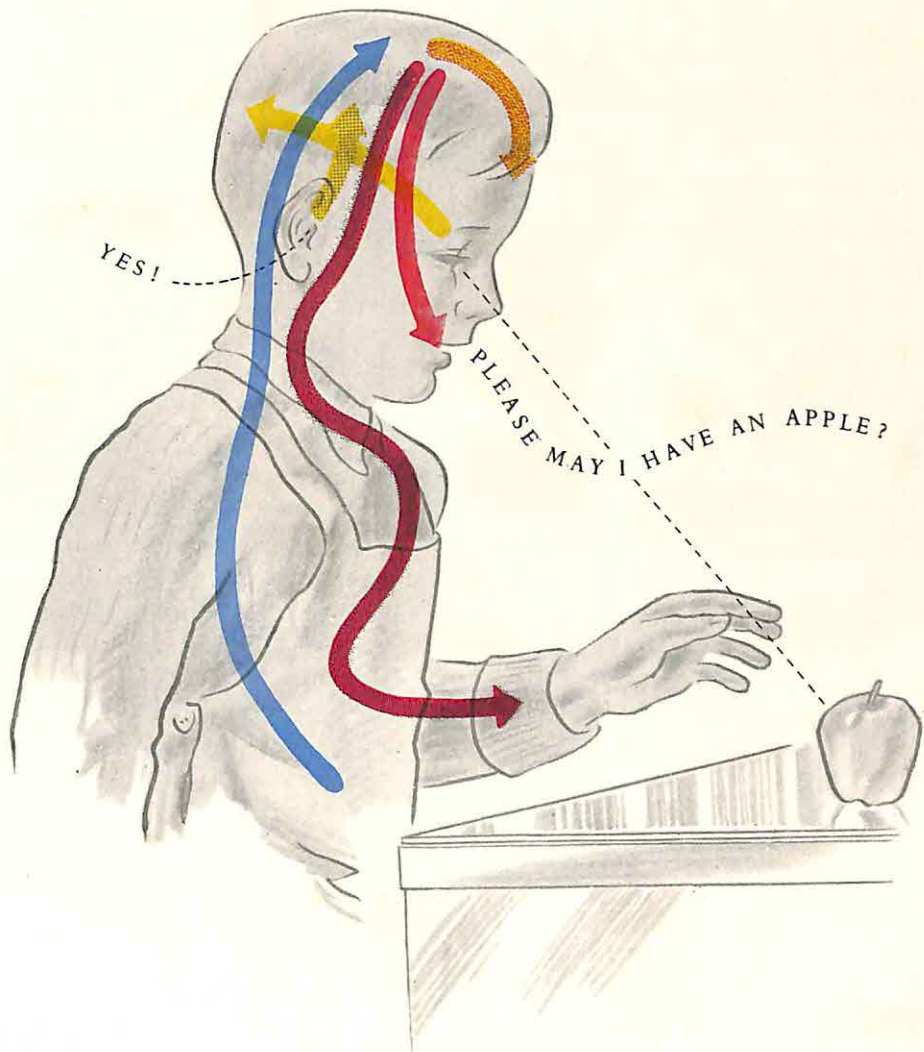
One part of the brain is mainly concerned with seeing, another part mainly concerned with hearing, another with speaking, another with feeling, another with breathing, and so on.

The front part of the brain is mainly concerned with thinking and remembering. This part of the brain is very much more developed in humans than in any other animal.

This diagram shows an example of the harmonious working of different parts of the body.

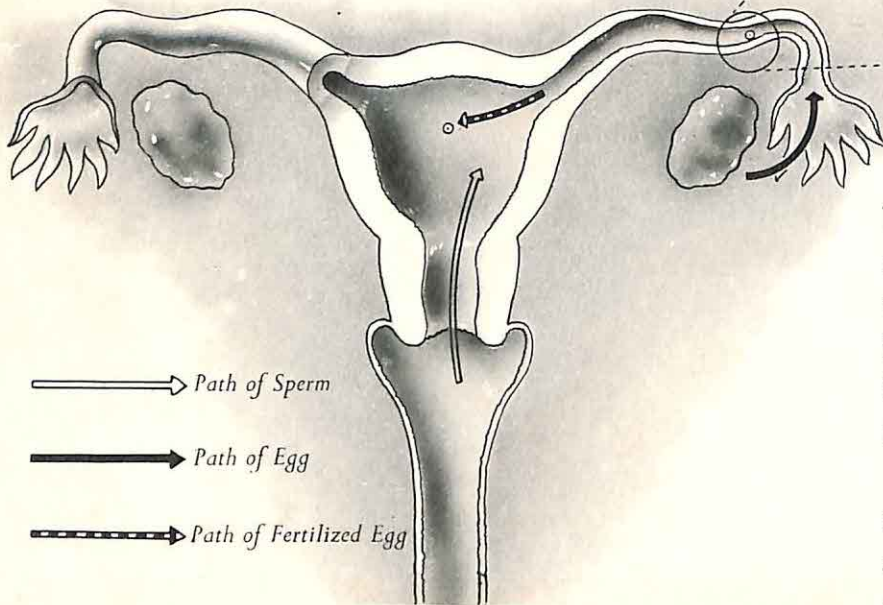
- Nerve endings in your stomach are sensitive to lack of food and a message passes up the spinal cord into the brain.
- The message passes on to the front of the brain, and you think: 'I am hungry'.
- Your brain passes messages down to your organs of speech, and you say to your mother: 'Please may I have an apple?'
- When your mother answers 'Yes', a message passes along a nerve from the ear to the brain.
- From your eyes, a message passes to the brain and tells it where the apple is.
- Messages pass along nerves from the brain to the muscles of the arm, and your hand reaches out and picks up the apple.

And it is really much more complicated than this!



The next generation

When a man and a woman marry and set up home together, they usually want children. The way in which new life is made is very wonderful. The penis is inserted into the vagina and the sperms pass in. They swim up along the tubes joining the uterus to the ovaries. If the sperms happen to meet an ovum passing down a tube from an ovary, one of them may fertilize it.



The fertilized egg then passes on into the uterus, and embeds itself in the delicate womb lining. Here it gets nourishment from the mother's blood, and grows safely for the next nine months, until it is ready to be born.

When a baby is ready to be born, the muscles of the womb begin to contract, and gradually force the baby down the vagina into the outside world.

The doctor or midwife cuts the navel cord, attends to the baby and to the mother – and there we have another member of the next generation.

At first, the baby is fed on milk from its mother's breasts, but eventually it is weaned to other food. If it has a good constitution, gets plenty of good food, is well clothed and housed, and forms healthy habits, it will grow from strength to strength.

When there is a new baby, the father and the older children can help the mother to look after it. There are all sorts of ways in which the different members of the family can help to make the home a happy place for the baby to grow up in.

SOME OTHER BOOKS TO READ

If you have been interested in this book, you will perhaps wish to look at some others dealing with the same and similar subjects. There are several very good books in the Pelican series written for adults but worth examining by older children also. These are:

Human Physiology, by Kenneth Walker
The Physical Basis of Personality, by V. H. Mottram
The Science of Seeing, by Ida Mann and Antoinette Pirie
Grow Up – and Live, by Eustace Chesser

Three books in the *Puffin Story Book* series deal with the work of great scientists, and are well worth reading:

Discovery, by Sir Richard Gregory
The Insect Man, by Eleanor Doorly – 2s 6d
The Radium Woman, by Eleanor Doorly – 2s 6d

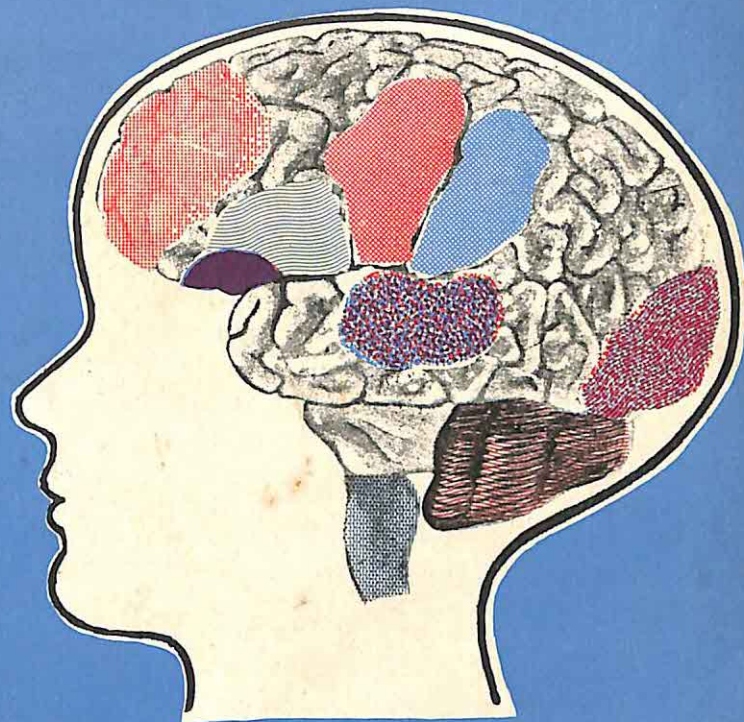
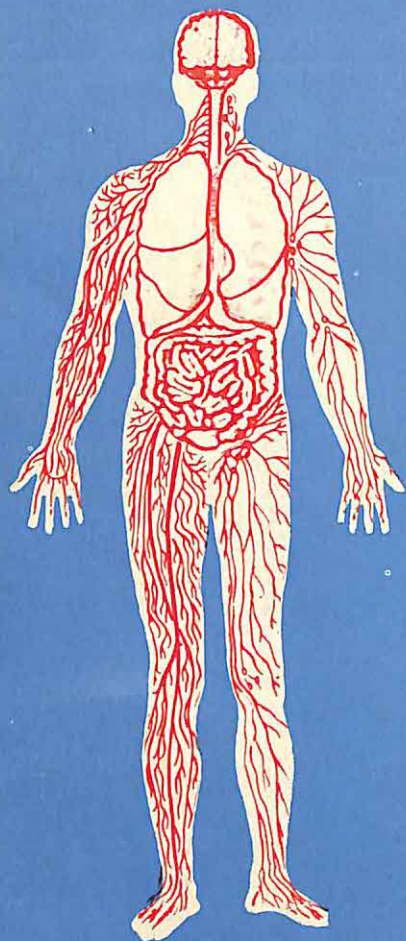
Some of these books may be out of print, but they will probably be in your School Library or the local Children's Library.

Younger children (up to about eleven or twelve years of age) may like to read three little volumes written by Cyril Bibby, the author of this book, and illustrated by Ian Morison. They are *A Healthy Day*, *Healthy and Happy* and *Healthy People*, published by Macmillan & Co.

Finally, if you would be interested to read more about the human body and the way it works, and to learn about some simple observations you can make and experiments to perform, there are two other books by Cyril Bibby, namely:

An Active Human Biology, published by W. Heinemann Ltd
How Life is Handed on, published by Thomas Nelson & Sons Ltd

THE HUMAN BODY



By Cyril Bibby and Ian T. Morison

